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Original Research Article

Impact of Directed Problem-Solving Education on Secondary School Students' Physics Achievement

Fagbenro Waliu Ayoola[1*], Samuel Garpiya Bileya[1]
[1]Department of Science Education, Federal University Wukari, Nigeria

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Abstract: This study looked at how students' achievement in Physics in senior secondary school one was affected by explicit problem solving instruction. A quasi-experimental pre-test-post-test design was used. The study involved two student groups: the Experimental Group and the Control Group. While the control group did not receive formal teaching on problem-solving techniques, the experimental group did receive such training. Utilizing the Physics Achievement Test, data were gathered and analysed using descriptive statistics and ANCOVA. The findings show that providing clear guidance on how to solve problems improves students' achievement in physics. According to this study, providing clear instructions on problem solving was beneficial for both males and females. To improve students' achievement in Physics, physics teachers should provide clear guidance on problem solving to their students.

Keywords: Problem solving technique, Physics Achievement, STEM, Senior Secondary school, Nigeria.

INTRODUCTION

The importance of STEM (science, technology, engineering, and mathematics) education for the sustainable growth of any nation has received attention from all around the world. This suggests that there is no denying the importance of STEM education for a nation's long-term social, economic, and political development. According to Mazana *et al.*, (2018), given the importance of STEM education, educators should support students in pursuing their interest in the subject to raise awareness and prepare them for participation in social and economic activities both domestically and internationally. In an effort to address global issues and generate employment, the Sustainable Development Goals (SDGs) 2015–2030, in particular objective number nine, centre on sustainable industrialization and encourage technological innovation. This can be effectively accomplished by prioritizing STEM education and making sure that everyone, particularly students, are well-engaged in the subject as they will make up a large portion of the workforce in the near future.

Globally, STEM education has been recognized as the area of most importance for the rapidly evolving technology-driven world (Ismail, 2018). In an effort to develop STEM-literate societies prepared to handle the ever-increasing difficulties resulting from scientific and technological transformation, governments and scholars have been attempting to identify relevant ways to address the situation. Nonetheless, interventions are still needed to be made throughout the continents, with Africa being the focus, in order to prepare the future workforce to assume leadership roles in this area (Han *et al.*, 2022; Leyva *et al.*, 2022; Sáinz *et al.*, 2022). This suggests that the continent of Africa is not creating enough STEM workers to support the region's sustainable growth. This was identified in the UN strategy paper on STEM as a facilitator of peace and development (United Nations, 2022). According to a research, the majority of higher education students in Africa pursue subjects connected to the social sciences and humanities, with less than 25% of them enrolling in STEM programs. In contrast, the United States of America has a different picture, with over 30% of bachelor's and master's degree holders having STEM education, 50% of research doctorates having STEM education, and nearly 65% of professional doctorates having STEM education (United Nations, 2022). Apart from a small number of scientists worldwide, women are recognized to be underrepresented in STEM, particularly in the domains of engineering and manufacturing as well as information and communication technologies (ICT). The Global Gender Report of 2022, in example, contains data from the World Economic Forum that shows that women

***Corresponding Author:** Fagbenro Waliu Ayoola
Department of Science Education, Federal University Wukari, Nigeria

graduates in ICT received 1.7 percent globally, while men graduates received 8.2 percent. In the fields of engineering and manufacturing, women made up 6.6% of the workforce, compared to men's 24.6%. In an effort to ensure that no child is left behind, this situation necessitates significant actions throughout the globe, but especially in Africa. To help prepare students for a variety of occupations in the sector, boys and girls in and out of school systems should be given support in discovering their abilities and fostering an interest in STEM. To improve the current state of affairs, authorities from the government, legislators, and academia should collaborate to develop innovative solutions.

Developing scientifically educated people with the intellectual tools needed to advance the advancement of man as a rational being is the main objective of science education. Teachers' primary goal is to help pupils acquire the scientific thinking skills necessary to address problems in and out of the classroom. The ability to solve problems is a crucial component of education. Problem solving is one of the abilities for lifelong learning that students of all ages must master (Jonassen, 2010 in Mataka, Cobern, Grunert, Mutambuki & Akom 2014). Throughout their lives, people solve a variety of challenges with varied degrees of complexity. There are poorly structured problems and well-structured problems (Jonasssen, 2010). Informally, people run across these problems in a variety of contexts, including formal schooling. As per the findings of Mataka, Cobern, Grnert, Mutambuki, and Akom (2014), students generally encounter organized challenges during their formal education. According to Johansen (2010), these problems involve a restricted set of rules and principles that are arranged in a predictive and prescriptive manner, have accurate, convergent answers, and have a preferred, prescribed solution process. Even while problems with less structure are typically simpler, some problems with more structure can nevertheless be quite difficult for students to solve. As stated by Jonassen (2010), problem solving generally comprises explaining the problem, obtaining information on the steps involved in coming up with a solution, drawing conclusions from the problem's current state to the solution, and finally validating and evaluating the solution. Adegoke (2017) assert that problem-solving skills are not inherited but may be learned and developed. Students learn more efficiently when they have the opportunity to actively participate in the scheduled activities and when they successfully solve the provided problem. As a result, teaching students to solve problem more skillfully is a crucial topic that science education needs to address.

Strategic instruction is a term commonly used to describe cognitive treatments that attempt to teach problem solving in an organized way (Çalişkan, Selçuk, and Erol, 2010). With the aid of instructional strategies, students are led and able to follow a series of steps to streamline learning and find the solution. To address problem solving performance, however, one of the most important instructional strategies that have been used is explicit problem solving instruction, which Adegoke (2017) defines as teacheing students directly how to use more advanced techniques for solving problems. Schoenfield (2013) as cited by Mataka, Cobern, Grunert, Mutambuki, and Akom (2014) assert that one of the main factors influencing a person's success in problem solving is how well they apply heuristic strategies, which are a subset of problem solving strategies. Heuristics help to convert a non-procedural cognitive skill to a procedural one (VanLehn *et al.*, 2004). In order to move from an initial, current state to a desired goal state, problem solving is defined as a goal-directed behavior [that] requires an appropriate mental representation of the problem and the subsequent application of certain methods or strategies (Metallidou , 2009 as stated by Mataka, Cobern, Grunert, Mutambuki, and Akom (2014). In their studies of the mental processes people use to learn and solve problems, cognitive psychologists (Sternberg, 1981; De Jong and Ferguson-Hessler, 1986) emphasized the importance of organizing knowledge to enhance the effectiveness of retrieving it from conceptual schemata during problem solving. The goal, according to Adegoke (2017), is to link and arrange knowledge in long-term memory so that it may be quickly retrieved when needed. As a result, cognitive techniques to problem solving were developed. According to cognitive psychologists, problem resolution entails self-reflection, making observations, and developing heuristics (Hardin, 2002 in Mataka, Cobern, Grunert, Mutambuki, and Akom, 2014).

Renowned cognitive psychologist Polya (Hardin, 2002 in Mataka, Cobern, Grunert, Mutambuki, and Akom, 2014) developed a methodical paradigm for problem solving. These included: comprehend the issue, create a plan, execute the plan, and reflect backward. Since these methods are not content-specific, they are simply referred to as general problem-solving techniques (Hardin, 2002 in Mataka, Cobern, Grunert, Mutambuki, and Akom (2014). It has been demonstrated by researchers (Carson & Bloom, 2005) that whereas Polya's steps seem to go in a straight line, they are actually cyclical. In their study on mathematicians' approaches to problem solving, Carson and Bloom (2005) found that mathematicians usually go through one step, remember something, and then double-check before continuing. According to Carson and Bloom (2005), mathematicians typically went back to the design stage when the solution was deemed unacceptable during the verifying process. In order to aid in the search for a suitable solution, proficient problem solvers first develop a description of the issue (Mataka, Cobern, Grunert, Mutambuki, and Akom (2014). This is accomplished by transforming the issue into a format that is simple to comprehend. The essential ideas needed to define the issue must be included in this synopsis.

When answering physics problems, inexperienced students usually go right into quantitative expressions without giving the problem any thought (Adegoke, 2017). Teachers have discovered that inexperienced students use methods such as random formula searching and pattern matching while solving problems. The purpose of physics education is to improve students' physics literacy while also assisting them in understanding fundamental physics topics and the nature of physics. Students who receive a physics education will be more inclined to continue their physics studies in school and beyond because they will see the practical applications of physics and technology in their daily lives (Adegoke, 2017). Problems in physics are typically stated verbally and require thorough study to identify the nature of the problem, the relevant data, the mathematical system being used, and the laws and principles of physics being applied. When solving problems, students must first convert spoken statements of relationships into formulae by representing the linked elements with letter symbols (Adegoke, 2017). They must then apply the relationship as indicated by the equation to solve the problem. Four main types of obstacles arise when tackling physics problems: understanding, organization, manipulation, and decision-making.

One of the primary challenges encountered by numerous students when addressing physics problems is comprehension. When a student encounters any of these challenges, it is highly likely that their problems stem from a lack of vocabulary, ineffective reading practices, an inability to differentiate between what is known and what is unknown, an inability to formulate the essential portion of the problem in their own words, or an incapacity to recognize hidden questions, interpretations, and implications (Adegoke, 2017). Though old, Johnson and Gerald (1967) proposed a few teaching strategies that may be applied to eliminate this kind of challenge. Several teaching strategies were proposed, including the following: physics instructors should help students receive specialized training in using dictionaries; physics instructors should train and encourage students to pose relevant questions to themselves and offer clarifications to uncover meanings concealed in the replies; Students to read slowly, carefully, and critically as well as summarizing what they have read in one's own words are habits that physics teacher should instil in their students. Determining how the problem-solving process is structured is the next type of difficulty that is likely to generate problems. Incapacity to discern between important and irrelevant information and an inability to understand fundamental relationships are a few of the factors contributing to this difficulty (Adegoke, 2017). To assist students in resolving such issues, the physics teacher should: draw students' attention to the selection of relevant facts with inquiries such as -what is given? What search criteria must be met? What information is required to address the question? Furthermore, why must one use some of the data provided in the problem statement while ignoring other facts? Along with teaching students how to recognize fundamental relationships, useful formulas, and unanswered questions, a physics instructor should also assist students in developing the capacity to construct problems that are comparable to one another but not overly challenging to solve. The third category of challenges related to problem-solving involves the ability to carry out the task. A number of factors can contribute to this kind of challenge, including a lack of understanding of the fundamental physics laws and principles that the problem is framed in, ignorance of the implications of the mathematical system's basic algorithms and formulas, and carelessness in practical application (Çalişkan, S., Selçuk, G. S., & Erol, M., 2010).

Çalişkan, S., Selçuk, G. S., & Erol, M. (2010) recommended that teachers assist students in learning the following techniques to enhance their problem-solving abilities: go over the fundamental laws and principles that underlie the concept for a clearer understanding; and analyze the formulas and algorithms (problem-solving techniques that may or may not involve mathematical equations) for a better understanding of the physics concept's structure. This is required because, in the words of Cohen, Kennedy-Justice, Pai, Torres, Toomey, DePierro, and Garafalo (2000), problem solving could turn into "an exercise in mere symbol manipulation" if students do not grasp the basic mathematical concepts that are used in it. These concepts include the meaning of ratios, the change of subject and formula, inverse and linear relationships, and so on.

In response to this frequent occurrence, Cohen *et al*., (2000) propose meaningful problem solving in the classroom, stating that teachers should demand that students demonstrate their conceptual understanding of all problem-solving techniques, including the equations and ratios used, rather than being satisfied with numerically correct answers when students are solving quantitative problems. They also suggest that this process of developing conceptual understanding of problem solving should take place at the secondary level because it may take longer in a college course. In general, teaching pupils how to solve problems should include teaching them the following abilities, among others: Building an informative diagram of the physical situation; recognizing and listing given information in variable form; recognizing and listing unknown information in variable form; recognizing and listing the equation that will be used to determine unknown information from known information; substituting known values into the equation and using the appropriate algebraic steps to solve for the unknown information; and verifying the final answer to ensure that it is reasonable and mathematically correct are all examples of competence.

Previous research on the impact of problem-solving training on scientific students' achievement

(Cohn *et al*., 2000; Bunce & Heikknen, 1986) indicates no gain in student achievement. Bunce and Heikkne's (1986) study involved the implementation of a program aimed at teaching students problem-solving techniques in general chemistry. In order to enhance their capacity to answer mathematical questions in chemistry, study participants were taught to adhere to a set of problem-solving procedures. The ability of the instructed students to solve problems did not improve, according to the results. In a similar vein, Cohen *et al*., (2000)'s study's findings demonstrate that teaching students problem-solving strategies, together with justifications and illustrations, doesn't really improve their ability to solve problems. However, according to certain research (Çalişkan, Selçuk & Erol, 2010; Ghavami, 2003; Jeon, Huffman & Noh, 2005), teaching children how to solve problems can raise their academic performance. The experimental group's students' achievement improved more than that of the conventional group in Jeon, Huffman, and Noh's (2005) study, which used thinking aloud pair problem-solving instruction in a Chemistry class.

According to the findings of Çalişkan, Selçuk, and Erol's (2010) study, students who were taught problem-solving techniques outperformed their peers who employed the conventional method, which did not include problem-solving technique instruction, on the Physics Achievement Test. Research conducted in classrooms has placed a lot of emphasis on gender as a reliable indicator of human behaviour. Research attempts to correlate sex differences with physics learning outcomes have yielded inconsistent findings, making it difficult to draw firm conclusions on gender disparities in physics achievement. Research generally indicates that boys excel in more theoretical and logical disciplines like physics and math, while girls excel in more creative fields like literature and painting (Ariyibi, 2010). The research, however, doesn't provide much evidence about how much problem-solving training can raise or lower girls' physics achievement. Nonetheless, more boys than girls enrolled in high school physics education programs. Finding teaching strategies that can entice more girls to study physics is necessary if efforts are to be made to boost the enrolment of females. This is because more girls are likely to be drawn to physics if they score well in the subject (Adegoke, 2012). These divergent findings indicate the need for more research in this area. Furthermore, there is a lack of adequate documentation in the physics education literature regarding the generalizability of these results to African settings. This led the author of the study to investigate the potential benefits of problem-solving education for improving students' performance in secondary school physics as well as the potential negative effects on girls' physics achievement while receiving such instruction.

Hypotheses

1. The mean scores in Physics of students who were given problem-solving instruction compared to those who were not show no significant differences.
2. Between students who got problem-solving instruction and those who did not, there is no significant gender difference in the mean results for Physics.
3. The Physics Achievement Test mean scores of the students do not exhibit an interaction between treatment and gender.

METHODS

Sample

Quasi-experimental design was used in this investigation. In the Ado-odo/Otta Local Government Area of Ogun State, Nigeria, two schools were chosen at random. Only science class I (SSS I) was chosen in each of the senior secondary schools (SSS). In science class in the majority of Nigerian schools, pupils choose to take physics, chemistry, and additional maths. Only those pupils who listed physics, chemistry, and additional mathematics as likely subjects for the senior secondary school certificate exam were chosen for this study. There were forty girls and 58 boys among the 98 total students.

The individuals' ages (Mean Age = 16.7; Standard Deviation = 0.78) fell between 14 and 16 years old. Two categories existed: Group I: This was the school where the students learned about vertical motion under gravity and also received education on problem solving approaches. There were thirty boys and twenty-three girls among the 53 students in this cohort. Group II: Students learned vertical motion under gravity in this school, but the instructor did not place much emphasis on problem-solving strategies. There were forty-five students in this group—seventeen females and twenty-eight male.

Materials

Two instruments were employed in this investigation. The Physics Achievement Test (PAT) and Instructional Guides were used. Form A and Form B were the two versions of the instructional guides. While Form B provides the recommendations for the teacher in the traditional method group, Form A contains the guidelines for the teacher in the problem-solving group. The teacher's actions in each group are outlined in the two formats.

Group I – Form A

The students in this group were exposed to problem solving techniques in addition to instruction on the meaning of the concept of vertical motion under gravity.

Steps
In a typical lesson the teacher and the students' activities were the following:

Introduction
The teacher
Step I: Introduces the topic by writing it on the white marker board and communicates the focus of the lesson
Step II: Link the new lesson with entry behaviour.

Presentation
The teacher
Step III: Explains the content of the topic by giving the definition and explaining the concepts
Step III: Asks the students to check for the meaning of the concepts, using dictionary
Step IV: Write formulas and equations for solving numerical problems and explain all the variables in it.
Step V: Takes the students through the process of how to carry out change of subject of the formula for each of the variables.
Step VI: Solves examples of problems involving all the variables in the formula and equations

Evaluation
The teacher
Step VII: Writes questions involving solutions of all the variables on white marker for the students to solve
Step VIII: Asks the students to solve all questions in their note books
Step IX: Guides the students in explaining the content of each problem and what they were asked to solve
Step X: Tells the students to explain why they think the answers to the problems were correct

The students
Step XI: Using the techniques learnt, solve the problems in their note books and explain how they arrived at their solutions to the problems

The teacher
Step XII: Gives correct solutions to the problems for the students to review the steps for getting correct answers
Step XIII: The teacher and the students discuss the deficiencies and mistakes on the solutions which the students give to the problems

Group II – Form B
The students in this group were exposed to instruction on the meaning of the concept of motion under gravity and no explicit instruction on techniques for solving problems was given.

In a typical class the teacher and the students activities were the following:

Introduction
The teacher
Step I: Introduces the topic by writing it on the white marker board and communicates the focus of the lesson
Step II: Links the new lesson with entry behaviour.

Presentation
The teacher
Step III: Explains the content of the topic by giving the definition and explaining the concepts
Step IV: Gives formulas and equations for solving numerical problems
Step VI: Solves three examples of problems using the formula and equations

Evaluation
The teacher
Step VII: Writes three questions on the white marker board for the students to solve
Step VIII: asks the students to solve the three questions in their note books
The students
Step XI: Solve the problems in their note books using the formula and equations.
The teacher
Step XII: Calls on a volunteer student who has solved the problem to show the solution to the problem on the board. The teacher however guides the student.
Step XII1: If a problem could not be solved by the student the teacher then explains how to solve the problem on the chalk board.

The major differences in the instructional techniques of the contrasting groups are in steps

Physics Achievement Test (PAT)
The topics on vertical motion under gravity were chosen for the selection of items. Every item was given a score between 0 and 4 on a 5-point scale. The General Partial Credit Model of Item Response Theory was used to calculate each item's difficulty and discrimination indices. There was a minimum score of 0 and a maximum score of 20.

Procedure
The researcher visited the schools prior to the experiment and begged for the assistance of the principal and the physics teacher, encouraging the students to participate in the study. There were three teaching sessions, one for the pretest and one for the posttest. These took place during the regular time scheduled for physics on the official time table, to avoid disruptions to regular school schedules. Two physics teachers participated in this study; each holds a B.Ed (Physics) and has six (6) years of experience teaching. The teachers

were randomly assigned to the groups. The two teachers used the instructional guides provided by the researcher. The study lasted one week.

Method of Data Analysis

The standard deviation and mean scores for each group were computed. Analysis of Covariance (ANCOVA) was used to test the hypotheses at the 0.05 level of significance. This was done to account for the effects of variables and check for any significant differences between the group means.

RESULTS

The order in which the hypotheses were put forward is followed while presenting the results.

Hypothesis One: The mean scores in Physics of students who were given problem-solving instruction compared to those who were not show no significant differences.

Pre-test:

Students in group one had a mean score of 4.01 (SD = 1.01) on the pre-test, while students in group two had a mean score of 4.17 (SD = 1.11). This demonstrates how similar the two groups were before to the trial.

Table 1: The mean score (pretest) of the groups

Treatment Group	Number	Mean	Std. Deviation	Mean Difference
Group 1	53	4.01	1.01	0.16
Group 2	45	4.17	1.11	

Post-test:

Table 2 shows that the mean score of the students in group1 is 12.87 with standard deviation of 2.9, and that of group is 10.37 with standard deviation of 3.7. The mean difference is 2.40. There is a difference between the groups' mean scores.

Table 2: The mean score (post test) of the groups

Treatment Group	Number	Mean	Std. Deviation	Mean Difference
Group 1	53	12.87	2.94	2.40
Group 2	45	10.37	3.70	

Table 3: Tests of Between Subjects Effects

Source of Variation	SS	df	MS	F	Sig.
Corrected Model	207.987[a]	4	51.997	4.725	0.018
Intercept	2299.752	1	2299.752	208.765	0.000
Covariate 2	13.679	1	13.679	1.242	0.269
Treatment	120.105	1	120.105	10.903	0.001
Gender	3.601	1	3.601	0.327	0.558
Treatment *Gender	20.215	1	20.215	1.835	0.180
Error	1024.488	93	11.016		
Total	11654.001	98			

Table 3 shows that the difference between conditions was significant $F\ (1{,}93) = 10.903, p = 0.001$). This led to the rejection of the null hypothesis. The study found that the instructional strategy used was responsible for the observed difference in mean scores between the two contrasting groups. The computed effect size of 0.096 was considered modest. Most importantly, treatment accounted for around 9.6% of the observed variation in the students' mean scores. That is, teaching pupils problem-solving strategies can improve their performance in physics. This is due to the fact that Group I students outperformed Group II students, who gained a score of 6.20 (Posttest [10.37] – pretest [4.17]) compared to Group I students' 8.86 (Posttest [12.86] – pretest [4.01]) gain.

Hypothesis Two: Between students who got problem-solving instruction and those who did not, there is no significant gender difference in the mean results for Physics.

Table 4: The mean score of the boys and girls in the Post test

Gender	Number	Mean	Std Deviation	Mean Difference
Male	58	11.60	3.44	0.20
Female	40	11.80	3.69	

From the table, the girls had higher score than boys. However, the mean difference of 0.20 was small and not significant F (1, 93) = 0.327, p =0.558. The null hypothesis was accepted. The calculated effect size of 0.003 was very small.

Hypothesis Three: There is no interaction effect of treatment and gender on the mean scores of the students in Physics Achievement Test. A further analysis of boys and girls scores in the two contrasting groups was carried out to note which of the gender benefitted more from instructions in problem-solving.

Table 5: The mean score of boys and girls across and within and across groups

Treatment	Gender	N	Mean	Std Deviation
Group 1	Male	30	12.88	
	Female	23	12.79	
Group 2	Male	28	10.24	
	Female	17	10.48	

From Table 5, both boys and girls in Group I performed better than boys and girls in Group II. In fact boys in Group I with Mean Score of 12.88 gained better than their colleagues (Mean score of 10.24) in Group II. The mean difference was 2.64. The difference in the mean score of girls across the groups was 2.31. These results point to the fact that instructions in problem-solving are useful for both boys and girls. It enhanced girls' achievement in Physics as well boys' achievement.

DISCUSSION

The findings of this research indicate that providing students with clear guidance on problem-solving techniques can improve their performance in Physics. This is true since solving word and numerical puzzles is a fundamental aspect of physics. Physics is full of formulas and equations that deal with ideas and subjects like angular motion, fluids and fluid motion, forces, moments of inertia, linear motion, projectile motion, motion under gravity, simple harmonic motion, thermodynamics, work and energy, as the previous paragraph made clear.

Since many physics concepts are conveyed through equations and formulas, students who perform well in the subject must be able to solve numerical problems utilizing these equations and formulae. The present study's findings, which indicate that problem-solving instruction enhanced students' physics learning outcomes, are consistent with the findings of Çalişkan, Selçuk, and Erol (2010), McCalla (2003), and Ghavami (2003), who discovered that providing students with problem-solving instruction in Physics could augment their academic performance.

The findings of this investigation, however, differed from those of other investigations, including Cohen *et al.*, (2000). For instance, the findings of Cohen *et al.*, (2000)'s investigation on the impact of problem-solving training on students' scientific achievement revealed no discernible increase in student achievement. In particular, the study conducted by Cohen *et al.*, (2000) demonstrates that teaching students problem solving strategies, along with justifications and illustrations, is not very beneficial in improving their problem solving skills.

The fact that efforts were made in this study to ensure that the students had a conceptual comprehension of the topics taught during the experiment was one of the reasons why the results did not agree with those of Cohen et al. In experimental Group I, for instance, the teacher took the time to clarify the distinction between the "time of flight" and the "time that the object took to reach the maximum height." Many students are sometimes perplexed when studying about motion under gravity because they mix the words "time of flight" and "time that the object took to reach the maximum height."

This issue typically results from a failure to comprehend the formula's shift in subject. Additionally, students must use their entrance skill to identify their learning gaps while working through problems. Furthermore, as Huffman (1997) points out, an explicit issue solving approach addresses a problem from both the quantitative and qualitative perspectives, whereas traditional problem solving solely considers the quantitative components of the problem. It's possible that this qualitative component of the explicit problem-solving process helped students better grasp physics ideas and concepts in addition to improving their problem-solving abilities. It may be stated that in this particular scenario, explicit problem solving instruction outperforms traditional problem solving instruction in terms of students' achievement in physics.

CONCLUSION AND RECOMMENDATION

In line with the findings of this study, physics teachers should endeavour to in addition to teaching the concepts in physics, instruct their students on how to solve numerical problems.

The study's conclusions suggest that physics instructors should try to educate their students how to solve numerical issues in addition to physics ideas.

By ensuring that students comprehend the concepts and problem-solving strategies sufficiently, this can be accomplished. Teaching students how to choose relevant facts that are needed to solve an issue is something that physics teachers should be doing. It's imperative that the pupil understands what is being taught. What is needed to be located? In order to respond to the question, what should we know? Furthermore, what justifies the usage of some facts while excluding others that are included in the problem statement? Since both boys and girls in this study benefited from specific problem-solving education, it is possible that more girls will be drawn to physics if secondary school physics teachers implement this strategy.

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